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走査型電子顕微鏡（SEM）を用いた北極域の積雪に含まれるブラックカーボンの観察

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Scanning Electron Microscopy (SEM) analysis of Black Carbon in Arctic snow

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Snow and ice on glaciers in Arctic contain various atmospheric depositions, such as soot (black carbon) and mineral dusts. These light-absorbing impurities can reduce surface albedo and affect melting of glaciers. Thus, it is important to understand optical characteristics of the impurities on Arctic glaciers. In this study, we analyzed structure and surface chemistry of black carbon collected from snow in several Arctic regions (Siberia, Alaska, Greenland, and Sapporo) with Scanning Electron Microscope (SEM, QUANTA FEG 450) and Energy Dispersive X-ray Spectrometer (EDS).

Microscopic observation revealed that snow samples from Alaska, Greenland and Sapporo contained black carbon particles with chain-like structures and compact aggregate structures (Fig. 1 and 2) as shown in Scarnato *et al.* (2013). However, the proportion of these black carbon structures were different among the samples. For example, snow from Greenland contained higher abundance of chain particles, while that from Alaska contained higher compact particles coated by membrane like material (Fig. 3).

本研究では、極域雪氷圏に供給される大気エアロゾルの気候変動への応答、および放射強制力への影響を評価することを目的として、走査型電子顕微鏡（SEM）を用いた北極域積雪試料中のブラックカーボンの構造観察および化学成分分析を行い、その空間的変動を考察した。

顕微鏡観察の結果、アラスカおよび札幌の積雪サンプルには、いずれも直径 10 - 100 nm の同サイズの球形粒子で構成された、鎖状の構造を持つ粒子（図 1）と凝集体構造をもつ粒子（図 2）が含まれていた。また、EDS による定性分析の結果、これらの粒子にはいずれも、C, O, Si, S, Na, Cl などの元素が含まれていることがわかった。これは、先行研究で報告されているブラックカーボン粒子の構造（e.g. Scarnato *et al.*, 2013）に比較的近い特徴であることから、本研究で観察されたこれらの粒子もブラックカーボンであると考えられる。しかし、その粒子構造の割合はサンプルによって異なり、グリーンランドのサンプルには鎖状の構造を持つ粒子が多く含まれるのに対し、アラスカのサンプルには薄い膜状のものでコーティングされた凝集体粒子が多く含まれていることが明らかになった（図 3）。

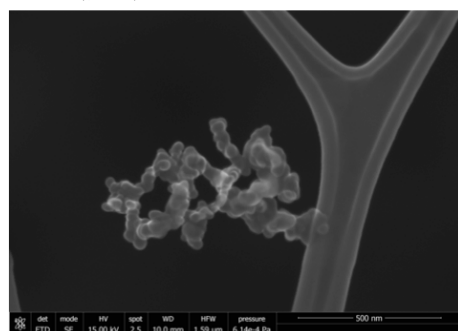


Fig.1 Chain particles in snow from Alaska

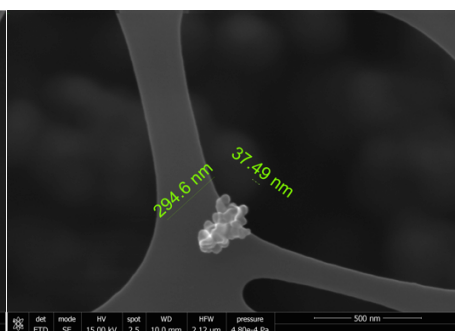


Fig.2 Compact particles in snow from Sapporo

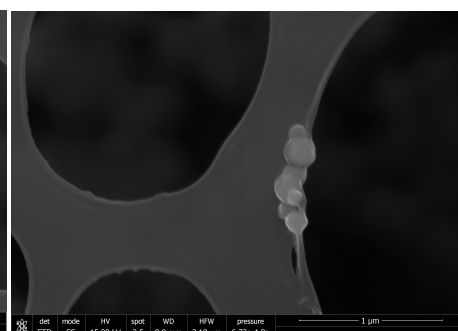


Fig.3 Coated particles in snow from Alaska

References

Scarnato, B.V *et al* (2013): Effects of internal mixing and aggregate morphology on optical properties of black carbon using a discrete dipole approximation model, *Atmos. Chem. Phys.*, Vol.13, 5089-5101.